DOCUMENT RESUME

ED 410 105 SE 060 468

TITLE	Block Scheduling: Teaching Strategies for the Restructured School Day.
INSTITUTION	National Science Teachers Association, Arlington, VA.
REPORT NO	ISBN-0-87355-163
PUB DATE	97
NOTE	40p.
AVAILABLE FROM	National Science Teachers Association, 1840 Wilson Blvd., Arlington, VA 22201; phone: 1-800-722-NSTA (NSTA Stock No. PB139X).
PUB TYPE	Guides - Classroom - Teacher (052)
EDRS PRICE	EDRS Price MF01 Plus Postage. PC Not Available from EDRS.
DESCRIPTORS	*Block Scheduling; Educational Change; Educational Innovation; *Educational Strategies; *Flexible Scheduling; Grouping (Instructional Purposes); Science Activities; *Science Curriculum; Secondary Education; Standards; Student Evaluation

ABSTRACT

This book is a compilation of articles taken from the National Science Teachers Association (NSTA) journal entitled "The Science Teacher" that pertain to block scheduling and strategies for effective science instruction within this framework. Articles include "Blockbuster Ideas" (Judy Bohince and Ireve King), "Tackling Block Scheduling" (Martha M. Day and others), "Blocking in Success" (Sylvia L. Cooper), "Year-Round Science" (Marilyn J. Stenvall), "Building Block Schedules" (Janet L. Gerking), "New Class on the Block" (Terrilee Day), "A Lesson in Block Scheduling" (Robert Barnes and others), and "Managing Each Minute" (Michael Clough and others). Also included are a forward and an introduction that relate this new approach to current goals and standards for science education. An invited paper on block scheduling provides background information about the process and its effects on teaching and learning (K. Doug Kissler). (DDR)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

PERMISSION TO REPRODUCE AND DISSEMINATE THIS MATERIAL IN OTHER THAN PAPER COPY HAS BEEN GRANTED BY
Sarah Melton
TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

U.S. DEPARTMENT OF EDUCATION
Office of Educational Research and Improvement
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)
☒ This document has been reproduced as received from the person or organization originating it.
☐ Minor changes have been made to improve reproduction quality.
• Points of view or opinions stated in this document do not necessarily represent official OERI position or policy.

BLOCK SCHEDULING

ED 410 105

SE 060-468

BEST COPY AVAILABLE

National Science Teachers Association

BLOCK SCHEDULING

Teaching strategies for the restructured school day

National Science Teachers Association

Acknowledgments

The National Science Teachers Association is the world's largest organization dedicated to improving science education on all levels—preschool through college. Membership in NSTA brings educators into a vibrant organization of more than 53,000 science teachers, science supervisors, administrators, scientists, business and industry representatives, and others representing every facet of science education. NSTA conducts national and regional conventions that attract more than 30,000 attendees annually. NSTA provides many programs and services for science educators, including awards, professional development workshops, and educational tours. NSTA offers professional certification for science teachers in eight teaching level and discipline area categories.

Block Scheduling is published by NSTA—Gerald Wheeler, Executive Director, and Phyllis Marcuccio, Associate Executive Director for Publications. The book was developed by the staff of *The Science Teacher*—Janet L. Gerking, Editor; Shelley Johnson Carey, Managing Editor; Mike Donaldson, Associate Editor; Kim Marie Alberto, Design Manager; and Lauren Beben, Editorial Assistant. The book was produced by NSTA Special Publications.

Design and front cover photos by Kim Marie Alberto. Back cover photo by Mike Donaldson. Inside photos as credited.

For more information about NSTA or any of its publications, call 1-800-830-3232 (membership); 1-800-722-NSTA (publication sales, North America); or 703-243-7100 (main number). We invite you to visit our web site at http://www.nsta.org, or e-mail us at membership@nsta.org (membership); pubsales@nsta.org (publication sales); thescienceteacher@nsta.org (*The Science Teacher*); or spubs@nsta.org (special publications editorial).

Copyright 1997 by the National Science Teachers Association, 1840 Wilson Boulevard, Arlington, Virginia 22201-3000. Permission is granted in advance for reproduction for classroom or workshop instruction. To request permission for other uses, send specific requests to Special Publications, NSTA, 1840 Wilson Blvd., Arlington, VA 22201-3000. The mission of the National Science Teachers Association is to promote excellence and innovation in science teaching and learning for all.

National Science Teachers Association
1840 Wilson Boulevard
Arlington, VA 22201-3000

Stock Number# PB-139X

ISBN # 0-87355-163

Printed in the U.S.A. by Kirby Lithographic Company, Inc.

Table of Contents

Introduction v
Janet L. Gerking

Foreword vii
Juliana Texley

Invited Paper 1
K. Doug Kissler, Reprinted from The Science Teacher, *April 1995*

Blockbuster Ideas 2
Judy Bohince and Irene King, Reprinted from The Science Teacher, *September 1996*

Tackling Block Scheduling 7
Martha M. Day, Clair P. Ivanov, and Stephen Binkley, Reprinted from The Science Teacher, *September 1996*

Blocking in Success 10
Sylvia L. Cooper, Reprinted from The Science Teacher, *September 1996*

Year-Round Science 14
Marilyn J. Stenvall, Reprinted from The Science Teacher, *September 1996*

Building Block Schedules 17
Janet L. Gerking, Reprinted from The Science Teacher, *April 1995*

New Class on the Block 22
Terrilee Day, Reprinted from The Science Teacher, *April 1995*

A Lesson in Block Scheduling 25
Robert Barnes, Joyce Straton, and Mary Ukena, Reprinted from The Science Teacher, *September 1996*

Managing Each Minute 26
Michael P. Clough, Randal J. Smasal, and Douglas R. Clough, Reprinted from The Science Teacher, *September 1994*

Introduction

Restructuring has been of particular interest to teachers because many secondary schools have reorganized their school days since 1990. Schools also have investigated alternative or organizational models such as site-based management. These changes have often led to other phases of reorganization within school districts such as changes in graduation requirements, switching to performance-based assessments, and including more project-oriented science programs.

During the NSTA national convention in St. Louis, NSTA High School Committee members identified key issues of interest to secondary science teachers. For the second straight year, block scheduling headed the list. Restructuring initiatives, assessment tools, and curriculum applications of the *National Science Education Standards* were also priorities.

Block scheduling has provided the class time needed for teachers implementing the inquiry approach, as suggested by the *Standards*. Class blocks that average 80 to 120 minutes allow for more hands-on activities, inquiry, cooperative learning, and projects. As some of the articles in this anthology indicate, teachers participating in a block schedule report having time to use assessment strategies appropriate to the instruction. Block scheduling allows students to work together in teams or as cooperative learning groups with more time to investigate scientific problems.

According to the five-year study conducted by the Center on Organization and Restructuring of Schools at the University of Wisconsin–Madison, "In schools where most teachers feel they can make a real difference in students' academic performances, students learn more and learning is more equitably distributed" (*WCER Highlights*, vol. 8 no.1). The study also showed that greater achievement gains in math and science were seen in schools that allow teachers to "adapt their practices to reflect students' needs." These schools, according to the study, gave teachers more opportunity to develop a curriculum focusing on high-level learning for all students.

The emphasis on alternative assessment has affected the way teachers look at student achievement. Because some restructured schedules allow for more teacher preparation time, teachers have begun to develop rubrics to evaluate performance and to use portfolios more often.

Changing the structure of the school day was just one step in a long process for many of the secondary schools implementing longer class blocks. With restructuring came a need to change the way teachers teach, extensively review the curriculum, and finally test and evaluate students differently and more effectively.

PHOTO BY ELIZABETH McNEIL

With the release of the *National Science Education Standards* in spring 1996, even more districts began to investigate the possibility of block schedules to provide teachers more time to complete tasks with students. As the *Standards* emphasize, lecture and memorization in 45 minutes of science instruction have never led to a population with a high degree of scientific literacy. The *Standards* clearly support student inquiry as the method for achieving greater understanding of science concepts and developing investigative skills. Block scheduling has led to some exciting variations in teaching strategies to implement inquiry. Some teachers report using warm ups such as journals entries, review activities, and preview activities. Teachers in block schedules also promote inquiry through classroom movement, cooperative learning, media and computer activities, videos, large group discussions,

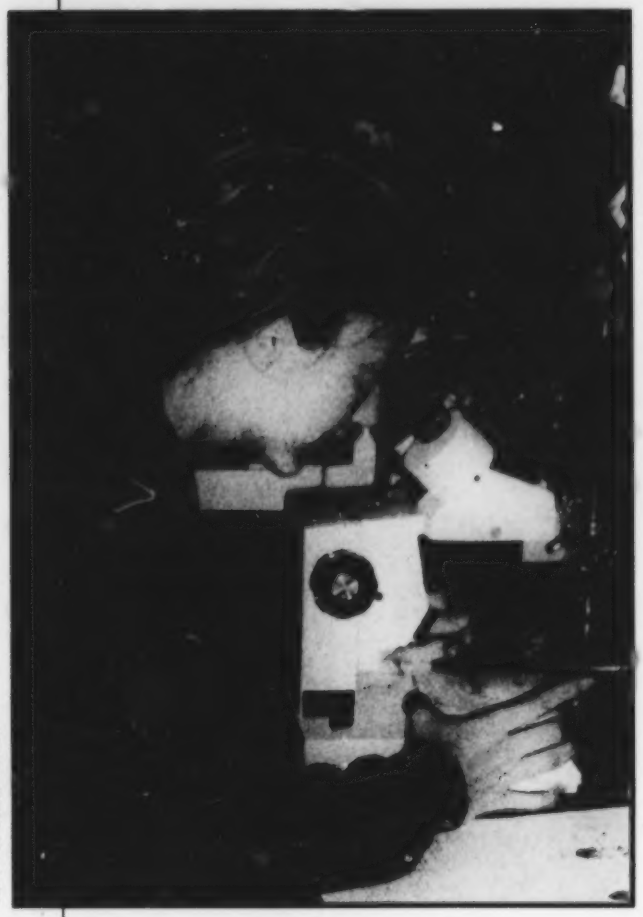


PHOTO BY DEBRA VENZKE

integration with other disciplines, peer teaching, and projects.

As Rodger Bybee, Content Working Group chair for the *National Science Education Standards*, wrote in an Invited Paper in the January 1995 issue of *The Science Teacher*, students need to develop the understandings, concepts, and abilities identified in the *Standards*. Teachers have concurred in subsequent publications that block scheduling gives students more time to work on these skills.

The *Standards* also call for systemic change and coordination. Donald G. Hackmann, in the November 1995 issue of *Educational Leadership*, lists a "systems thinking approach" as the number one step in implementing block scheduling. He states that once his faculty members saw 90-minute blocks "as dramatically affect[ing] teaching styles, which would in turn affect building climate in other, more substantive ways," they began to see the whole process of restructuring as interrelated parts of a system.

Despite the obvious benefits, the move by school districts to block scheduling has not been without controversy. Some schools adopted a four-by-four system that alternates four periods every other day for the entire school year. Others try to complete courses in one semester. Some schools schedule eight traditional-length periods on Friday after alternating four 90-minute periods the first four days of the week. As the articles in this publication indicate, all of these schedules have been successful in some schools. At the same time, other schools have failed miserably and returned to a more traditional schedule.

One factor is consistent among schools that proclaim success in block scheduling–professional development. Training their teachers to work within a longer class period helped the teachers make better use of the additional time. The teachers and parents were also an integral part of the preplanning process. Block scheduling often led to systemic reform as teachers and administrators dealt with a new set of conditions for learning.

This collection brings together many of the ideas, examples, and suggestions science educators have published recently in *The Science Teacher* on this special topic of restructuring. Many thanks go to Shelley Johnson Carey, managing editor of *The Science Teacher*, who conceived the idea of compiling these articles for use by teachers and districts. NSTA has also published *NSTA Pathways to the Science Standards* to help teachers assimilate the *Standards* and provide a model for the classroom. *Pathways* also includes strategies associated with block scheduling.

As teachers continue to implement the tenets of the *National Science Education Standards* in their classroom teaching strategies, the ability to spend more time with students in one long block will certainly be a factor in their success. We hope this publication will help all science educators learn from the successes of their colleagues.

Janet Gerking
Editor, *The Science Teacher*
Science Teacher, Laramie High School
Laramie, Wyoming

Foreword

To reach the vision of the *National Science Education Standards*, educators have had to discard many basic assumptions of the past. Challenging the connection between credits and hour-long classes is just one way schools have used the *Standards* to provide students the gift of time. New schedules—blocks, flexible schedules, and built-in coplanning—have been piloted to help improve both instruction and achievement.

Taking a fresh look at a typical high school schedule from the perspective of the *Standards* has shown us a frustrating and disjointed learning environment. In a traditional 50-minute period there might be:

- Five minutes for change of class
- Five minutes for attendance (and perhaps more to provide makeup work)
- Ten minutes to set up an activity
- Twenty minutes to race through the steps
- Ten minutes to clean up, and then perhaps...
- Five minutes or less to reflect or discuss.

The frenetic pace of hour-long classes does not accommodate the learning styles of many adolescents. Is it any wonder that so many find it difficult to concentrate for more than a few minutes at a time? Or that teachers often miss students' confusion or misunderstandings? The teaching standards that encourage us to plan, facilitate, and finally assess and interact as a community of learners, all the while remind our students to watch the clock!

Systematists believe that much of what we take for granted in structuring school programs has been built not around educational principles, but upon support services—"buns and buses." When most American schools were in rural areas, it was a given that most students arrived and left at the same time. It was easiest to create three half hour lunches in a 90-minute midday period. On a foundation of hour-long classes, systems built teacher contracts and cooperative programs that rushed students out of schools and into the workplace. The Carnegie Unit was defined as an hour and the semantic connection stuck.

Because so many noninstructional services have been built around secondary schedules, schools that move toward the teaching standards often must begin by developing new models of cooperation within their systems. To change the schedules in high schools, teachers have had to learn to communicate with noninstructional departments and their school community. High school schedules cannot operate independently from other schools and departments.

For the schools mentioned in this volume, new scheduling systems often begin by asking a series of questions. Can classes be held at different times on different days? Can periods be set aside from make-ups, tutorial, mentoring, enrichment, or club activities? Can teacher coplanning be built into an early morning period (when teachers are fresh and students can sleep a little longer?) Those initial questions led to many others:

- How might attendance be monitored if students have choices during a given period?
- Can the food service department accommodate a schedule that varies by day?

PHOTO BY ELIZABETH McNEIL

- Will a varied schedule accommodate middle school students who spend part of their day in accelerated classes at the high school?
- Can transportation provide opportunities for rural

students to attend makeup classes if students miss a two-hour block?
- Can the scheduling software accommodate alternating day schedules?
- Will the employers of cooperative education students be willing to offer flexible student employee schedules?
- Can the teacher contract be amended to reflect prep periods that vary by the day or week?

More and more often, the answer to such questions in schools is yes. If interdepartmental teams build their work around the System Standards then these goals can be achieved:

1. Common vision—shared purpose among instructional and support staff.
2. Coordination—a willingness to consider change in every area
3. Continuity—support from elementary and middle school staffs as schedules are changed.
4. Resources—consideration of what is possible within existing budgets without marking territory.
5. Unanticipated effects—the sort of global thinking that brings staffs from all areas together to examine all aspects of a change.
6. Individual responsibility—every member of the school community sharing responsibilty for change... and every member of the team meeting the challenge to eliminate "it can't be done" from his or her vocabulary.

Schools searching for more "time on task" have often found it in block scheduling. They have accommodated longer and more thoughtful science laboratory experiences, in-depth research and process writing in language arts, and sectional and individualized explorations in the arts. They have taught students the value of extended concentration, and even challenged the conventional wisdom that secondary students find it difficult to remain on task. Longer periods allow more reflective exploration and accommodate different learning styles. Teachers have a greater opportunity for discourse to identify prior knowledge and misconceptions. Students learn to work more carefully and avoid accidents. Each of these advantages provides a key to progress toward one or more of the science standards.

Perhaps most importantly, school teams that work together to explore changes in scheduling

PHOTO BY KEN EISNER

learn new models for cooperative change. Often what begins with a few minutes on the clock grows into a productive examination of the other dimensions of learning in a system. Many schools have learned that they *can* move toward the *Standards* with existing resources, if they move together.

This volume describes only a few of the models that schools have explored to change scheduling and increase student achievement. The change that would be most important for your school and community will probably not be found in its entirety here but may begin here and be nurtured by the synergistic creativity of your team. Adjusting the clock is just one way that schools across America are preparing to *reset* their calendars for the twenty-first century. What options are possible for your school and your students?

Juliana Texley
Superintendent, Anchor Bay Schools
Anchor Bay, Michigan

Invited Paper: Block Scheduling

Many schools hoping to significantly improve instruction are currently considering changing from a traditional schedule to a block schedule. While change is often good, I do not believe in initiating change without a good reason.

My school district required a switch from a six-period day to a schedule that offered seven options to the students. After investigating a variety of schedules, we narrowed the choices down to two block schedules. The first system consists of four 90-minute classes that meet every day. Each semester represents one year of traditional school work. Under this schedule, students take four classes each semester and can progress through the equivalent of eight yearlong classes each school year. Advantages in this system are that students are able to take more classes during their four years in high school, the intensive study of four classes per semester caters to students who find it easier to focus on fewer subjects at a time, the number of students that teachers work with each semester is reduced, and students can compensate for deficits in their course work.

For example, if some students enter high school a year or two behind their classmates in math, they can take math every semester. By the time they graduate they could have taken eight years of math. But this could also be a disadvantage because an aggressive student could easily consume all of the course offerings in a department and demand more instruction.

Some other disadvantages can also be identified. Students and teachers make contact half as many days as they would under a traditional system. The teachers and students have to maintain a brisk pace to cover a year's worth of material in 90 days. Any significant illness can lead to such a great loss of course material that a student may find it impossible to catch up. Also, the teacher has to modify lessons to cope with the greater time and pace of the class.

The second block system also has 90-minute periods, but the classes meet every other day and the students finish a year course in a traditional year. Within this system, the opportunity to have eight course offerings remains, but the pace is different. Lesson plans can usually be used for two days, which reduces stress. Loss of class time due to illness is less critical because missing two consecutive days is effectively missing only one period of each class.

Some of the disadvantages are that students cannot accelerate their academic programs, students who thrive on daily contact struggle under this system, and meeting with the students half as many days as the traditional schedule requires a significant change in the curriculum.

The faculty at my high school opted to use the second block plan because it keeps students closer to a traditional year, which helps the students who transfer into or out of our school. We also felt that spreading the course work over the school year would give students more "processing time" for difficult subjects. Finally, since we were only required to offer seven classes per year, we used one period for advisement during which students can study and get help in any subject.

Some of the advantages and disadvantages cannot beidentified until you are in the middle of the system. We discovered that the curriculum has to be modified. The block schedule reduces the amount of instruction time per year. In our science classes we eliminated or reduced some topics and enhanced others. In classes like math, where the courses are more sequential, the reduction in curriculum has major effects as students move into their third and fourth years. The longer periods are great for lab classes. It is often possible to introduce, conduct, and discuss a lab in one period. This continuity reduces the amount of review time necessary if an experiment is spread over three days.

Longer periods also require more activities per day. In a period not devoted to lab work, I try to have at least three different activities. Demonstrations, video lessons, mini-labs, or simple observations are used to keep class time from dragging as it would in a typical lecture. We do not have to rush to get through the lab procedure and clean up before the bell rings. The additional time to explore has enriched my classes more than I ever would have guessed.

As a final note, we found that the switch to a block schedule did not require a change in our budget at the building or department level. If anything, it reduced the demand on some of our equipment by spreading its use over seven periods.

Whatever schedule changes your school is considering, remember that you need to carefully examine what effect it will have on your methods of instruction, the students' methods of learning, and sequencing of courses.

K. Doug Kissler
Douglas County High School
Castle Rock, Colorado

PHOTO BY ANN ALFRED

BEST COPY AVAILABLE

Blockbuster Ideas

Activities for breaking up block periods

ONE OF THE BIGGEST CONCERNS among teachers considering block scheduling is how to organize a 90-minute class. As science teachers, we are familiar with giving our students hands-on lab activities, but even the most experienced teachers will need to find a few new tricks when first encountering extended blocks of time. Breaking the time blocks into a variety of student-directed activities is the key.

At Brentsville District, a combination middle-high school, we have implemented the four-by-four model of scheduling. This block scheduling method divides the school day into four 90-minute class periods. Students complete four classes by the end of the first term in January and four more classes by the end of the school year. This allows students to select eight courses per year instead of the six or seven in traditional schedules. It also means science teachers teach six classes instead of five, while repeating all labs and activities at two separate occasions in the school year. Faced with an increasing student population and decreasing revenues, our site-based management team selected the eight-period year as a way of providing more choices for students without requiring additional funding. Research suggested that attendance and grades would improve. Because this is only our second year, the jury is still out. But students and teachers have been surprised to discover that they enjoy the opportunities offered by longer classes.

BY JUDY BOHINCE AND IRENE KING

Veteran teachers of chemistry, physics, and physical science have discovered that old dogs *can* learn new tricks. First-time teachers cannot imagine surviving laboratory investigations in less time. Still, the essential question remains: How can we break the block into student-directed activities on a daily basis? We discovered how much fun learning can be when students do the "work" and teachers become the assistants in the learning process. Accordingly, we stick to this rule: Do not do anything that students can do. For example, teachers and assistants no longer put away equipment. Students are responsible for cleaning all equipment, setting up equipment for subsequent classes, patrolling the use of safety equipment at their desks, checking gas and water valves, and all clerical work. They evaluate one another's work, collect and return work, and in some cases do computer recordings.

Long-term planning is also important in student-directed learning. We give students yearly calendars with monthly schedules of activities and assignments. Time management is crucial. For short-term planning, students use personal agendas. Each Monday students record their objectives, assignments, and assessments for the coming week. Long-range assignment projects are also updated. This takes about 10 minutes, and each agenda is checked by the teacher to ensure that all students are at the same starting point. Each

Friday, we note the goals we achieved and plan objectives for the upcoming week.

We assign dual activities on block days to prevent curriculum deterioration. Slower students have time to complete assignments in class and work on a research or problem-solving activity while faster students may move ahead or work on a computer or library project. Projects are the keys to keeping students involved. National competitions and in-house rivalries encourage students to show off their best ideas.

Student support teams are essential for class leadership and mentoring. Support teams are made up of students who have demonstrated their abilities to succeed in a subject area. Students' appointments are based on grades, performance on tests or labs, and helpfulness. Support groups must have ability as well as desire and diligence to help with lab techniques and remembering assignments. A group of students can be recognized for its achievements or grades. In turn, the group serves for the marking period as assistants and class facilitators. In my classes, being a member of the support team is a successful motivator. These students serve as role models and encourage others to participate.

Flexibility and timeliness in grading is particularly important in the four-by-four block because students and teachers are looking at a different type of curriculum presentation. In a longer class period, there are different expectations for learning. Students learn how to use facts to solve problems and have the opportunity to do research in assessment activities.

Another method I have used to motivate students is a participation grade. I give all students a participation grade of 100 on a note card. Every time they volunteer, for example, to participate in class by putting a problem on the board or leading a class discussion, they earn an extra point. Sometimes I give extra points for bringing in lab supplies, such as soda cans or old candles. Students know they will have at least one 100+ grade in their average. (This helps to balance out a poor test grade or late assignment.)

FIGURE 1.

Suggested activities for a 90-minute science class.

1. Pasta physics: Twenty pieces of spaghetti and 1 meter of masking tape per student. Two 45-minute trials. Build the highest support system using only these two materials that will support your book for 30 seconds.

2. Paper towers: One legal-size sheet of paper and 1 meter of cellophane tape per group of three to five students. Two 45-minute trials. Construct the tallest tower that is free standing for 10 seconds. Go outside for real weather conditions.

3. Surface tensions wars: One penny and plastic pipette per pair of students. A liquid such as water, oil, or detergent. One 10-minute trial. Winners fit the most drops of liquid on either side of the coin. All students test the same liquids in each 10-minute period.

4. Chromatography races: Long strips of timer tape and a variety of solvents such as water, alcohol, or acetone. Liquid markers and ballpoint pens. Chromotography separates dyes by color. Different solvents dissolve the dyes, soak into the paper, and climb up the paper column. Different pens or markers will produce different results. Lab groups select materials and let the setup run overnight. The winner is the longest column in the morning.

5. Internet journals: Include Internet assignment as extensions in science journals. Students must use appropriate addresses to document scientific research. Research assignments could include journals, term papers, essays, or problem solving.

6. Traveling shows: Arrange for your students to visit younger classes to present projects or assist in demonstrations.

7. Outside connections: Students visit a work site and interview a worker. Oral report to class must show connection between chemistry and physics concepts and the real world. Work sites could include industrial research laboratories, college or university laboratories, hospital and medical centers, nutritional specialists, and electronic and computer labs. The home can also be a work site. One student in the the past researched the chemical reactions of baking, brewing, fermentation, and digestion.

8. Visiting scientist: Have students select a scientist with a birthday close to theirs and conduct visiting scientist days. Students report in first person and/or costume about the life and contributions of "themselves."

9. Physics/chemistry toy day: Have students bring in toys that utilize a concept of science and explain the toy and the science concept to class. Pre-evaluate for safety.

10. Element adoption: Assign each student an element. Projects can include reports, research or construction of an atom, and molecule games.

Contact the author for more activity ideas.

PHOTO BY MIKE DONALDSON

ACTIVITY IDEAS

Block scheduling activity ideas are available from articles and conferences, but some of the best ideas are passed by word of mouth from teacher to teacher. The two following activities and those listed in Figure 1 have been used successfully in our classrooms.

Studying Impulse

Objectives: The student will be able to demonstrate and explain the concept of impulse.

Materials: Balloons, plastic lab aprons, two or three metersticks (taped together lengthwise to fit the hem of a sheet), a twin-sized sheet.

Preliminary Discussion: Why do cars need bumpers? What happens to the forces in an auto accident when an airbag is deployed? How are various sports involved with "timing" the catch?

Prior Knowledge: Students should be familiar with applying the formula $F = ma$ and be able to identify forces as vector quantities.

Traditional Approach: In a 45-minute block, students discuss the above, do sample exercises, and receive written problems for homework.

Block Approach: In a 90-minute block, students spend a short time (15 to 30 minutes) doing the water balloon activity between the discussion and sample problems. This allows time to introduce momentum or assign a related activity.

Activity: Students fill balloons with water. Different amounts of water will lead to different observations. Students observe ways to slow down the impact time when the balloons are thrown at different surfaces. Students work in pairs. They should wear aprons and do the activity outside. In the first trial, students toss a water balloon back and forth with their partner. They study the difference between catching the balloon while moving and while standing still, then they discuss the results. In the second activity, students throw a water balloon at a bed sheet that is held taut. Tape metersticks end to end and slip them into the open hem of the sheet. Putting metersticks in the bottom edge will allow a lip to catch the balloons. Challenge each student to break his or her balloon against the sheet. If the sheet is held properly, the balloon cannot be broken. Then let each student try throwing a balloon against a hard surface such as a brick wall. Of course, the balloons will break easily. Discuss the difference between the sheet and the brick wall. This activity can also be done with eggs, but the clean up can be very messy.

Work and Compound Machines

Objectives: Students will be able to demonstrate knowledge of simple machines by designing and building a complex machine incorporating each of the six simple machines.

Materials: Assortment of pulleys, string, eyescrew, nails, duct tape, cardboard, metersticks, wooden blocks, and various vehicles with wheels and axles of assorted sizes.

(Students bring parts of building sets and roadrace sets from home.)

Preliminary Discussion: Why do people need machines? How are machines designed and built? What are some examples of machines that we "could not live without?"

Prior Knowledge: Students should be familiar with the formula Work = Force x Distance ($W = Fd$). Students should have learned about each of the simple machines and the method of determining the mechanical advantage of each.

Traditional Approach: In a 45-minute block, students pair up with a partner and work on the project outside of class. On a given day, students bring the project to class for presentation. (I have tried this project under a 45-minute block, insisting that students do the work in class. It took a week to complete because much time was lost to setting up and breaking down equipment. I also found that I became weary of dealing with the clutter and confusion of the week-long project and lost some of the enthusiasm that comes with the initiation of a construction project.)

Block Approach: In a 90-minute block, students spend a minimal amount of time setting up and breaking down their project. They have time to observe what their classmates are doing and to conduct and document several field tests of their compound machine. The activity is completed in two class days.

Activity: Students are given the materials collected beforehand and form task forces to design, build, and test a complex machine that can move a 150-gram mass a distance of 1 meter.

Design Parameters:

1. At least one example of each of the simple machines must be included.
2. The finished product may not exceed 1 meter high, 1 meter wide, or 1 meter long.
3. Students may not use glass, open flame, motors, rat traps, or CO_2 cartridges.

Task Force:

Group Leader—The group leader is in charge of making sure all team members participate and share equal work loads. The leader organizes the class presentation, designates duties as needed, and takes responsibility for carefully storing the project overnight. This person reports to the teacher and interacts with other teams.

Scribe—The scribe records test data, writes the project report, and assists with the construction of the machine.

Timer—The timer makes sure all team members remain on task and make maximum use of class time. The timer also makes sure that the project is completed on time and helps construct and test the machine.

Project Engineer—The engineer gathers input from all members and designs the model for the machine. Each modification should be reflected in subsequent sketches. The engineer supervises the field testing of the machine and makes any necessary modifications.

Students' written reports should include the machine name and a description of its operations, all design drawings (including modifications), results of at least six field tests, and an evaluation of the project including questions such as, How did the machine work? What were its strong points? What were its weak points? How could you improve the project? How might a machine such as this be used in real life? and What did you learn about work and machines? Oral presentations should include a demonstration of the machine and a question-and-answer session in which classmates can discuss the machine and offer suggestions.

As classroom strategies change, so too must classroom assessments. Small group projects require performance-based assessment. Rubrics must be clearly defined, and groups should be monitored continually to assure full student participation. With block scheduling, students are given the opportunity to exhibit learning on a variety of levels and are as involved in cooperative assessment as they are in cooperative learning.

Students are given the opportunity to exhibit learning on a variety of levels.

Block scheduling brings the opportunity and the necessity for including a wide variety of instructional activities. As science teachers we beg, borrow, or steal every idea that we see, hear, or read about that would add a spark to our regular lesson. As architects and builders of science blocks, we need to reach out to other science teachers and the multitude of available resource materials now more than ever. ✧

Judy Bohince teaches chemistry and physics, e-mail: jbohince@pen.k12.va.us, and Irene King teaches eighth-grade physical science, e-mail: iking@pen.k12.va.us, both at Brentville District High School, 12109 Aden Rd., Nokesville, VA 22123.

REFERENCES

Haven, K. F. 1994. *Marvels of Science*. Englewood, Colo.: Libraries Unlimited.

Tackling Block Scheduling

How to make the most of longer classes

MOVING FROM A TRADITIONAL schedule to a block schedule is not simple. During the 1995–1996 school year, Maplewood Comprehensive High School in Nashville, Tennessee, moved from the traditional six-period school day to the four-by-four block schedule (Figure 1), which offers eight full-credit courses per academic year. Students complete four courses, arranged in 90-minute blocks, during each semester. We have found that the benefits greatly outweigh the effort required to make the change.

Before implementing the change, we devoted much research, discussion, and study to determining if a block schedule would be advantageous to Maplewood students. Several Maplewood teachers visited schools using block schedules to provide our staff with firsthand accounts of how these schools operated. In the 1994–1995 school year, our principal implemented a rotating 90-minute period to allow teachers and students to experience a block period one day per week in each class. After investigating each aspect of the block schedule, students, parents, teachers, and administrators reached the consensus that Maplewood would change to the four-by-four block schedule. We chose the four-by-four block schedule over other types of block schedules because it offers simplicity, additional opportunities for students to gain credits for graduation, longer blocks of time for in-depth discussion and project-oriented learning, and fewer classes to contend with (four instead of six) each semester.

BY MARTHA M. DAY, CLAIR P. IVANOV, AND STEPHEN BINKLEY

MAKING IT WORK

Training and preparation are the keys to a successful transition. At the end of the 1995 school year, our administrators brought in a trainer for a two-day workshop on block scheduling. In addition, teachers in the same department were given release time to develop common syllabi to provide continuity in instruction.

Although the block schedule provides longer class periods for instruction, actual clock hours are lost by students completing courses in a single term. This facet of the four-by-four block schedule required us to reevaluate our curricula and prioritize our course objectives. Our guidance department prepared for the change by developing a new master schedule and tried to ensure that students were given schedules pairing two "high homework" courses with two "low homework" courses each term. Unique aspects of the four-by-four block schedule include the following:

- Students have only four classes per day rather than six.
- Students can earn eight credits per academic year rather than six.
- There is increased instructional time each day.
- Students take two core courses per term coupled with elective courses, thus allowing students more in-depth study time.
- The student-to-teacher ratio is reduced considerably.
- Teachers can implement more hands-on activities.

ARTISTIC ELEMENTS

Objective: Construct a creative visual aid such as a mobile or three-dimensional poster that describes an element.

Guidelines: Be prepared to give a five-minute presentation on your project. To construct the visual aid, you may use coat hangers, posterboard, construction paper, yarn, newspaper, magazines, cardboard, craft materials, or nontoxic materials in which the element is found. The visual aid should be colorful and interesting, and the information should be easy to understand. Include the following information about the element in your visual presentation:

1. Name and symbol.
2. Electron configuration notation.
3. Boiling point.
4. Melting point.
5. Specific gravity.
6. How it was discovered and who is given credit for its discovery.
7. Where it is produced or mined.
8. Cost.
9. Uses.
10. Atomic mass.
11. Atomic number.
12. Isotopes.
13. Chemical behavior.
14. Compounds in which it is found.

On a separate sheet of paper, list at least three references in the following format: Author(s). (Year published). Name of book/periodical/computer program, volume/edition, inclusive pages.

Evaluation: 30% following guidelines, 30% creativity, 30% presentation, 10% properly reporting references.

ELEMENTS OF FICTION

Objective: Write a short story, talk show, or play that describes an element. The key to this assignment is *creativity*.

Guidelines: Explain your adventurous life as a chemical element by describing the following:

1. How you were discovered.
2. Your name and symbol.
3. Your physical properties.
4. How you are produced.
5. How much you are worth.
6. How you are used.
7. Other elements you like to hang out with (compounds/group behavior).
8. Where you are located on the periodic table.
9. Your history.
10. Unusual and interesting facts about yourself.

Be sure to use the following format:

Cover Page—Include your name, class period, and the title of your story.
Story—The story must be two to five pages in length. Typing, word processing, and illustrations are optional.
Reference Page—List at least three references.

Editing: After you have written a draft of your story, please check it for grammar and spelling errors. Revise your draft and then submit it to your lab partner for review. Ask your lab partner to point out any necessary revisions and make suggestions for improvement. Then, write your final draft.

Evaluation: 30% content, 30% creativity, 30% grammar/spelling, and 10% references.

FIGURE 1.

Four-by-four block schedule.

First Block	7:00–8:30
Second Block	8:38–10:07
Third Block and Lunch	10:15–12:22
Fourth Block	12:30–2:00

We continually monitor and evaluate the four-by-four block schedule. So far we have observed many benefits. Daily attendance has increased because students have realized the importance of frequent attendance in semester-long courses. Our failure rate has decreased because students have more opportunities to engage in peer tutoring. Administrators report that discipline problems have diminished as a result of fewer class changes per school day. Textbook inventory procedures are greatly improved because students now are only responsible for handling four textbooks per semester and the texts are kept for only a semester as opposed to an entire school year. The quality and continuity of instruction have also improved through the longer period. Teachers are using more group learning, student presentation, and hands-on learning techniques. Students have more time available for acceleration and remediation because there are more opportunities to earn credit. Finally, teachers have more planning time each day (90 minutes as opposed to 55 minutes).

In the block schedule, science teachers at Maplewood have observed a need to shift from the traditional lecture-and-discussion format of instruction to a more hands-on, project-oriented curriculum. Asking students to sit and listen to the equivalent of two 55-minute lectures per day is unreasonable and negates the benefits that the block schedule is designed to accomplish. We have found that project-oriented instruction provides for a more meaningful interpretation of our course objectives.

In a survey conducted in the 1995–1996 school year, three-quarters of our students reported liking the four-by-four block schedule better than the traditional schedule and favored continuing the program in the 1996–1997 school year. One student responded, "I believe that the teachers are more motivated on this schedule." In addition, students generally felt that the new schedule would better prepare them for post-secondary education and entering the work force. One student gave a particularly instructive response: "If you have to sit still for the whole 90 minutes, the schedule is no fun."

The benefits of longer classes are obvious, especially when doing laboratory activities: We can brief students for a lab activity, perform the experiment, and debrief students all during one class. On the traditional schedule, we often found that students forgot the meaning of the experiment by the next class and were unable to analyze data and draw conclusions.

INTERDISCIPLINARY ACTIVITIES FOR A BLOCK SCHEDULE

The projects we have implemented in our curriculum serve to draw out students' creative abilities and to enhance their writing and organizational skills. In the Artistic Elements activity (top of page 26), students choose an element, locate specific information about the element, and report it to the class in a visual presentation. This project enables students to use their artistic abilities in science class and develops students' research and presentation skills. Students move to different work stations to locate information and materials. In addition, they are engaged in a hands-on activity in which they must find information rather than receive it from the teacher. The teacher must function as an encourager and motivator during this type of activity. Because many students are not accustomed to using initiative, it is important for teachers to keep students focused by setting small deadlines to be met at various points throughout the activity.

In Elements of Fiction (bottom of page 26), students write a short story, talk show, or play that describes an element's properties. Students learn to work together by reviewing and editing each other's work. When students have finished the project, they read their stories to the class, often using illustrations to enhance their presentations. This activity is a great tool for implementing writing across the curriculum. Furthermore, students must use organizational skills to develop a logical flow for the information they are required to report.

BLOCK SOLID

The four-by-four block schedule presents both positive and negative sides. Although we cannot cover as much material in the block schedule because actual clock hours are lost, we feel that the quality of instruction is better than is possible with a traditional schedule. Also, we realize that the success of the block schedule depends on continuous revision and improvement. One improvement that is planned for the 1996–1997 school year is the development of curriculum strategies that integrate vocational and academic curricula. With this, students will begin to value academic skills as a means for developing work skills.

While not a panacea for the problems encountered in education today, block schedules are certainly a step in the right direction. The vast majority of faculty, teachers, and students at Maplewood report that they would not go back to the traditional schedule. Our main goal is to continue to provide every means necessary to ensure the success of our students. We consider block scheduling to be an excellent option in striving to reach that goal. ✧

Martha M. Day teaches chemistry, Clair P. Ivanov teaches chemistry and physics, and Stephen Binkley teaches physical science, all at Maplewood Comprehensive School, 401 Maplewood Lane, Nashville, TN 37216.

BLOCKING in SUCCESS

Plan ahead for big dividends from a new schedule

SCIENCE TEACHERS HAVE BEEN KNOWN to carry stopwatches in order to prompt students working on lab activities in a typical 50-minute period: "Only 20 minutes left . . . The bell rings in 5 minutes . . . Are you cleaning up? . . . Two minutes left . . . Everyone has to be finishing up *now*."

Rushing through an activity is no longer a problem in science classes at Morgantown High School, a comprehensive 1250-student high school in West Virginia operating on a four-by-four block schedule since September 1993. On this schedule (also known as an AB block schedule), students attend 90-minute classes on a continuous alternating day schedule (Figure 1).

While the vast majority of teachers at our school are pleased with their block scheduling experiences, science teachers are the most enthusiastic. Having class periods that are nearly twice the conventional length means we have the flexibility to be more than time managers. If we are doing a traditional lab, we can do a pre-lab, lab, and post-lab all in one time block. If we are doing an innovative exploratory activity, students have the time to make and discover their mistakes, revise their plans, and re-try the activity. If students raise a question about an experiment, it is feasible to challenge them to design and try their own experimental resolution of the problem.

While laboratory flexibility is the most obvious benefit of block scheduling, the advantages extend to every aspect of our teaching:

- The extended time line gives the teacher an opportunity for imaginative planning,
- Students working in cooperative learning groups have time to make discoveries for themselves,
- Ninety minutes allows us to develop an entire idea in one sitting rather than dribble it out in several consecutive installments, and
- Exams can feature thought-provoking essays rather than fast multiple choice questions.

Our Advanced Placement Chemistry course, which was already being taught as a two-period block, has taken particular advantage of block scheduling. With the new schedule, it is offered in two consecutive 90-minute blocks every other day.

Lab activities that last longer than two hours are now possible. Our ongoing math-science collaboration also benefits from the longer sessions. In a 180-minute block, we can collect data for 90 minutes and have the math teacher do a mathematical analysis of the data during the rest of the block. The continuity between activity and resolution enhances our students' understanding.

BY SYLVIA L. COOPER

PHOTO BY KIM ALBERTO

HOW WE INITIATED BLOCK SCHEDULING

Our success in block scheduling was made possible by the initial steps we took. The schedule change was part of our general restructuring as a Benedum Project Professional Development School (PDS). As a PDS we enjoy an interactive collaboration with West Virginia University. This initiative has been underwritten by the Claude Worthington Bendedum Foundation and undertakes complete restructuring of the university's teacher education program, as well as all aspects of student learning. This also includes scheduling at Morgantown High School. The decision to adopt the four-by-four block schedule was made after a yearlong teacher investigation of alternative scheduling options, considerable discussion and debate, and a faculty consensus to proceed. Recognizing that the traditional lecture style of teaching was not compatible with the new schedule, we began extensive teacher training.

The June before the schedule went into effect, one-third of the faculty attended a day-long workshop on cooperative learning techniques. Those faculty members then trained the rest of the faculty in inservice sessions held before the start of the school year. All teachers have also had the opportunity to receive computer and Internet training, and were encouraged to use the flexibility of the block schedule to integrate technology into their teaching. Newsletters were sent to parents to inform them of the upcoming changes that would occur with the new schedule.

THE TWELVE-AND-A-HALF PERCENT FACTOR

The change has not been without cost. The biggest deficit has been a 12.5 percent loss in instructional time. Our students previously had no study hall. One hundred percent of the school day was dedicated to instruction. Our students now take seven courses and the eighth time block is scheduled as an Independent Research Period (IRP). That means that one-eighth, or 12.5 percent, of classroom time is no longer available for direct instructional purposes.

This change was necessary to provide daily planning periods for teachers. Because we were unwilling to penalize students with larger class sizes and no funds were available for additional faculty, we created the IRP to resolve the problem.

The positive outcome of this 12.5 percent dilemma has been that many students have made good use of the IRP. This has become the preferred time to make up tests and missed activities. Students working on independent research projects can go to the library or computer lab. Teacher or peer tutoring can also be provided during a student's IRP. For students who hold after school jobs, the IRP provides the time needed to complete homework assignments. Obviously not all students use their IRP to good advantage, but many do. In addition, students who have failed courses are permitted to schedule an eighth course in lieu of the IRP. This safety net of time has enabled some students to overcome what could otherwise have been an insurmountable deficit.

Nevertheless, a 12.5 percent shortfall has had an unquestionable impact on classroom content. It is not possible to cover all the material taught under our previous schedule. But what we teach is taught better. What we teach is retained better. What we teach is enjoyed more. But without question, as measured by a textbook's table of contents, we teach less. While we are all familiar with the idea that less is more, many of us were not at all convinced that this claim was valid in this case. As we trimmed and adjusted, assigned more material as independent study and made creative changes in our modes of classroom delivery, we all felt more than a little apprehension that the 12.5 percent shortfall would return to haunt us.

ASSESSMENT

As a Benedum Project PDS, we are fortunate to have an ongoing assessment project in place. It is possible to assess the impact of the block schedule in terms of student and faculty satisfaction and in terms of concrete test results.

Studies of the faculty and student populations indicate overwhelming positive support for the block scheduling initiative (Figure 2). Prior to starting the new schedule, students in lower level courses were quite sure it would be boring to be in the same class for 90 minutes. Interviews with these students now indicate overwhelming support for the system.

FIGURE 1.

Morgantown High School's block schedule.

Odd Day	Even Day	Odd Day	Even Day
Period 1	Period 2	Period 1	Period 2
Period 3	Period 4	Period 3	Period 4
Lunch	Lunch	Lunch	Lunch
Period 5	Period 6	Period 5	Period 6
Period 7	Period 8	Period 7	Period 8

- Odd and even days repeat on a continuous cycle.
- If school is unexpectedly cancelled, the schedule picks up to maintain the continuity of the rotation.
- If the school day is shortened, we have four slightly shortened periods.
- Students are normally scheduled for seven classes and one Independent Research Period.
- Teachers are scheduled for three instructional periods per day, plus one planning period and one shared Independent Research. Teachers therefore have alternating time-off blocks of 90 and 45 minutes per day.

FIGURE 2.

Results of external assessment of Morgantown High School's block scheduling.

Student survey item: "Having ninety-minute class periods has had a positive impact on my learning."

Response: 92 percent of students agree

In discussion groups and in response to open-ended questions, students surveyed commented that the block schedule offers:
". . . more time to discuss and talk with your teachers and figure out the problems."
". . . a little more individualized attention."
". . . a chance to learn more, like certain labs in chemistry and certain topics in different classes. And if [the classes] were cut off every fifty minutes, you would have to spend half of the next class reviewing what you talked about last time."
". . . it helps in labs because . . . for some of the labs we do [we need] the ninety minutes. I think the ninety minutes also helps [during class discussions]."

Students also commented on the impact of block scheduling on homework loads and expectations.
"One other thing I like about the ninety-minute classes is . . . you have more of a social life because you don't have homework for eight classes every night. You have [homework] for four, and it may be a little more, but . . . I think it's a lot easier because I can go home and do my homework for that day and not have to worry about it for another day."
"You also have to learn time management, especially with the ninety-minute classes. You can put off homework one night and it comes up the next night. All of a sudden you have something to do that night, and teachers don't really accept excuses for late homework because you had two nights to do it."

FIGURE 3.

Average ACT scores for Morgantown High School.

Year	Math	Sci Reason	Composite
School			
1990–91	20.3	21.2	21.1
1991–92	20.2	21.9	21.6
1992–93	20.1	21.7	21.2
1993–94*	19.9	21.7	21.4
1994–95**	20.8	21.7	21.6
State			
1990–91	18.5	21.1	19.8
1991–92	18.6	20.1	19.8
1992–93	18.6	20.1	19.9
1993–94	18.5	20.3	19.9
1994–95	18.5	20.4	20.0
National			
1990–91	20.0	20.7	20.6
1991–92	20.0	20.7	20.6
1992–93	20.1	20.8	20.7
1993–94	20.2	20.9	20.8
1994–95	20.2	21.0	20.8

* 1993–94 results are after one year of Block Scheduling.
**1994–95 results are after two years of Block Scheduling.

Many teachers initially shared students' fears. Concerns on how to fill 90 minutes were common, and worries about the net loss of instructional time were considerable. In contrast, current faculty interviews indicate a high level of acceptance. Teachers and students agree that returning to the traditional 50- minute schedule is unthinkable. Indeed, from time to time, mostly due to weather-related delays in the start of the school day, our four periods are "only" 60 minutes long. Everyone feels pressured, and it is common to hear students and teachers complaining about how they cannot possibly get anything accomplished in such a short time frame.

We have a number of statistical measures of the impact of our schedule change. While there is a tendency for schools undergoing reform to see their test scores drop significantly, we have not had that problem. Figure 3 shows a five-year summary of our ACT results. Our test results, which were already at or above state and national averages, remain steady. Every year our 11th-grade students take the Comprehensive Test of Basic Skills (CTBS) exams. Tracking our results before and after our schedule change again shows that our already strong scores remain steady (Figure 4). Indeed, this year we experienced a significant upswing in CTBS scores.

As an Advanced Placement Chemistry teacher, I was particularly concerned about possible negative consequences in my students' scores. Our AP Chemistry scores have consistently been 10 to 15 percent better than the national pass rate. Examination of our scores before and after block scheduling indicates that these scores have also held steady.

The Northern West Virginia section of the American Chemical Society sponsors a Chem One and Chem Two competition based on the ACS national exams. Our students have always received the top places in that competition. After we went to block scheduling our students continued to win top honors, and examination of test scores shows that, as with all other indicators, our already high scores remained steady.

Clearly block scheduling has not had any negative effects on our students' ability to do well on outside evaluation instruments. Concerns that this scheduling innovation might put our students at a disadvantage on standardized testing have been decisively refuted. In addition, the results of our assessment interviews and surveys show definite positive enthusiasm for this change. In the balance, it is clear that block scheduling at Morgantown High School has been a success. ✧

Sylvia L. Cooper teaches chemistry at Morgantown High School, 109 Wilson Ave., Morgantown, WV 26505; e-mail: coopers@access.mountain.net.

FIGURE 4.

Comprehensive test of basic skills—Morgantown High School scores.*

Year (Fall)	Total Reading	Total Language	Total Math	Total Basic Skills	Science
1991	65	59	61	63	66
1992	66	63	63	66	67
1993	72	70	69	71	71
1994**	65	63	62	66	69
1995***	75	71	71	75	75

* Test is designed so a score of 50 equals the national norm.

** Fall of 1994 test results are after one year of block scheduling.

*** Fall of 1995 test results are after two years of block scheduling.

Year-Round Science

Shorter year-end breaks plus longer classes equals success

IN TODAY'S COMPETITIVE, TECHNOLOGICAL world, training students to jam a year's worth of learning into nine months, telling them to vacation for a quarter of the year, and then wasting weeks of time reviewing what was forgotten is a plan best buried with the last century. At least, this is the view of science teachers in the Sweetwater Union High School District in Southern California, where the case for year-round schooling is well articulated at its newest high school.

Eastlake High School, drawing on the success of a year-round schedule at another high school in the district, adopted a calendar in which students begin the school year in July with nine weeks of classes, have a three-week break, come back for nine more weeks, and end the semester before Christmas. Semester two begins in January and follows the same pattern, with the intersession (a three-week midsemester break) backing onto the spring break week for a month's vacation. Graduation week falls at the same time as at traditional-calendar schools, and there is a vacation period of about a month between school years. This is a single-track calendar with all students and staff at school at the same time. Both student attendance and achievement have improved dramatically.

BY MARILYN J. STENVALL

Eastlake High moved to the year-round plan in the school's second year of operation, and therefore the science department had the opportunity to compare student progress under both systems. The consensus is that all students have improved, though the data are not yet available, but the "science-challenged" student has been the biggest beneficiary because of midsemester intersessions and the opportunity that exists to get tutorial help during each intersession.

Intersessions are an important part of this year-round calendar. The three-week break in the middle of each semester can be a vacation period for students or an opportunity to take a class offered for credit under the state's regular summer school funding. Enrichment activities are often scheduled during intersessions, such as study seminars for advanced placement students just prior to the testing period, which fit perfectly with the spring semester intersession. Special "safety net" tutorials are also provided. Classes are generally a half-day in length during intersession periods. According to Eastlake's science department chair Bill Johnson, the short breaks between school years provide a continuity that "makes it easier to teach and provides for better retention."

However, Johnson and the science department still feel the intersessions have not fulfilled their potential, and they recommend offering special courses and educational experiences not available during the regular semester. Exploratory courses such as archeological digs, coastline water and refuge observation and projects, day-long desert trips impossible during summer months, and other experience-rich plans are still in the discussion stages primarily because of limited funding.

PERENNIAL BLOCK SCHEDULING

Eastlake High went one step further when it moved into year-round education. It also made the move into a block schedule that features a setup day on Mondays, with all six 50-minute periods, followed by a Tuesday through Friday schedule of three 110-minute classes separated by a nutrition break and a lunch period.

How does this block plan work for science students? The science department is divided on this issue. Some labs work very well in the longer instructional period, but there is a real need for diversity in teaching. The block periods have proven to be best for students in advanced classes because these students typically have longer attention spans arising from their interest in the subject matter and the academic success they have experienced in prior science classes. Students with shorter attention spans, often enrolled in the required basic physical and life science classes, are more likely to require lessons planned with a variety of activities within the block period. Lessons for these students need to include a diversity of activities such as demonstrations, lab work, group discussions centering on lab results, student reporting, and of course, lectures and quizzes, optimally with four student activities within a single block period. There must be good planning on the part of teachers to accommodate these needs in a block schedule. Good teaching techniques regularly employed by the majority of effective science teachers are the resources applied to the new time frame in a block.

Eastlake's faculty, with a majority of the science teachers' approval, recently improved upon the block schedule by offering an "extended learning period." Class periods Tuesday through Friday now last for 100 minutes, and there is a 35-minute period between the first class and the nutrition break in which students can meet with teachers for extra assistance on special interest topics.

Bill Johnson says that if the extended learning period is primarily used to help students improve their grades, teachers can "concentrate on offering enrichment topics during intersessions that are in-depth in nature, more as a reward rather than catching up from the previous quarter." Not all students want or need to spend extra time with their science teachers during the

PHOTO BY MIKE DONALDSON

extended learning period, according to Johnson, and because there is a wide variety of activities available, the smaller group of students each science teacher has to work with will benefit academically.

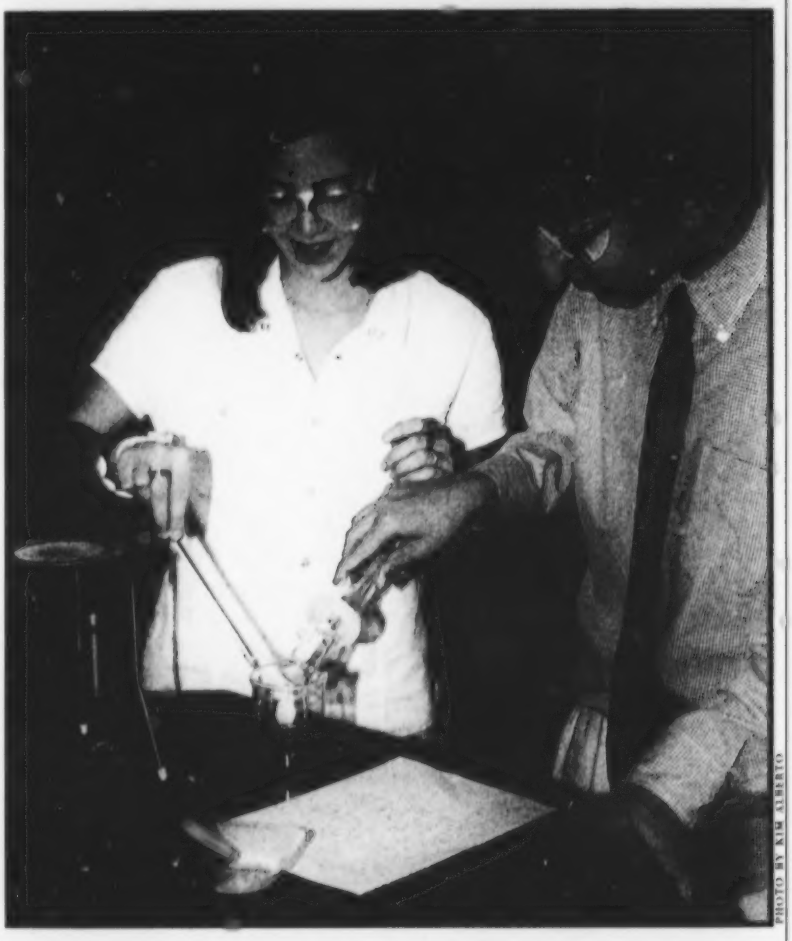


PHOTO BY KIM ALBERTO

TIME FOR CHANGE

In April 1994 the National Education Commission on Time and Learning reported on their study of the relationship between time and learning in the nation's schools. They concluded that students and educators are "prisoners of time, captives of the school clock and calendar." "No matter how complex or simple the school subject," says the report, "the schedule assigns each a national average of 51 minutes per class."

The report goes on to recommend restructuring schools around learning, not time. Although the National Education Commission recommends further funding for extending the school year and school day, year-round education today is the one alternative that can be employed at any school without spending additional funds. Schools can improve learning without waiting for a silver platter to deliver additional money, just as Eastlake High School has done with year-round education and block scheduling.

Research has verified achievement gains when the traditional, long summer break is divided up throughout the school year. A yet-to-be-published study on the effects of summer vacation on standardized test scores indicates that "students appear at best to demonstrate no academic growth over summer" and "at worst, students appear to lose one month of grade-level equivalent skills relative to national norms" (Cooper et al., 1996). The study further concludes that students lose most academic growth in math; in science, students are more likely to experience summer learning loss in facts rather than in concepts.

Science is too important to be left in the clutches of a school calendar invented in an era when students worked on the family farm during the summer. The study of science then was thought best left in the hands of the educationally elite. Our task is different today. Our global economy depends on a scientifically and technologically educated society. The question now is, Do we have the national will to capitalize on the preparation, background, and training of our teachers to work within the calendar and school day configuration that will provide the best education we have to offer? It is indeed time to reinvent schools around learning. Students will be better prepared to meet the challenges of the next century in science and math as well as in all academic disciplines as a result of our courage in exercising our support for change in the school calendar. ◆

Marilyn J. Stenvall is a senior consultant for secondary education, National Association for Year-Round Education, P.O. Box 711386, San Diego, CA 92171-1386.

REFERENCES

Ballinger, C. 1995. Prisoners no more. *Educational Leadership* 53(3):28–31.

Cooper, H. et al. 1996. The effects of summer vacation on achievement test scores: A narrative and meta-analytic review. Unpublished paper. University of Missouri-Columbia.

National Education Commission on Time and Learning. 1994. *Prisoners of Time.* Washington, D.C.: U.S. Government Printing Office.

Building Block Schedules

A firsthand assessment of restructuring the school day

WHEN OUR HIGH SCHOOL STAFF began considering block scheduling in 1990, we did not realize we were beginning a process of major restructuring and reform. Block scheduling reduces the number of classes in a school day and, in our case, increased the time per class from the more traditional 45 to 55 minutes to 90 minutes.

Over a period of two years, as our teacher/parent/student committees formulated a plan for changing the structure of the school day, the implications of the change seemed straightforward. In our school of 950 students, we wanted to move from six to seven contact class periods. We wanted more time to teach students, and we wanted to better prepare and advise all our future graduates. We focused our goals by writing a list of desired outcomes for science education. Science teachers were convinced we would have more time for labs, but we knew we would lose total minutes each semester. Could we really support the idea that "less is more," and would we be able to survive 90 minutes of teaching at a time?

RIGHT ON SCHEDULE

Over the past three years, we have begun to realize the true implications of restructuring to block scheduling. It leads to major changes and reenergizes a "burned out" faculty. It allows teachers, especially science teachers, more time to teach concepts that otherwise might be left hanging. A change to block scheduling must be accompanied by teacher in-service. It also requires that time be set aside each week for students and teachers to research and prepare for longer classes.

After two years of study, our faculty voted to implement a four-period day of classes that would meet every other day for 90 minutes (Figure 1). We formulated goals (Figure 2) and wrote our rationale for the change (Figure 3). While many schools schedule courses that meet daily for one semester, we felt it was more important to give students a full year to assimilate information—especially in courses such as chemistry and physics. We also decided not to vary the 90-minute times during the day or year. We devoted one block, called Student Enrichment Block (SEB), to student advising, make-up work, library study, and other activities. This block proved critical to science courses because it allowed students who missed a 90-minute block to make up chemistry labs, computer work, or physics projects.

Perhaps the greatest change, however, came in the way we now teach. Classes of 90 minutes are best divided into three 30-minute sections, two 45-minute sections, or three 20-minute sections with a 15-minute opening and closing. With the lengthened periods, we divide the block into times for more group work and activities. Lectures are limited to 10- to 20-minute segments. With more time, we use technology such as computers and graphing calculators to reinforce concepts and help involve all students in the material.

BY JANET L. GERKING

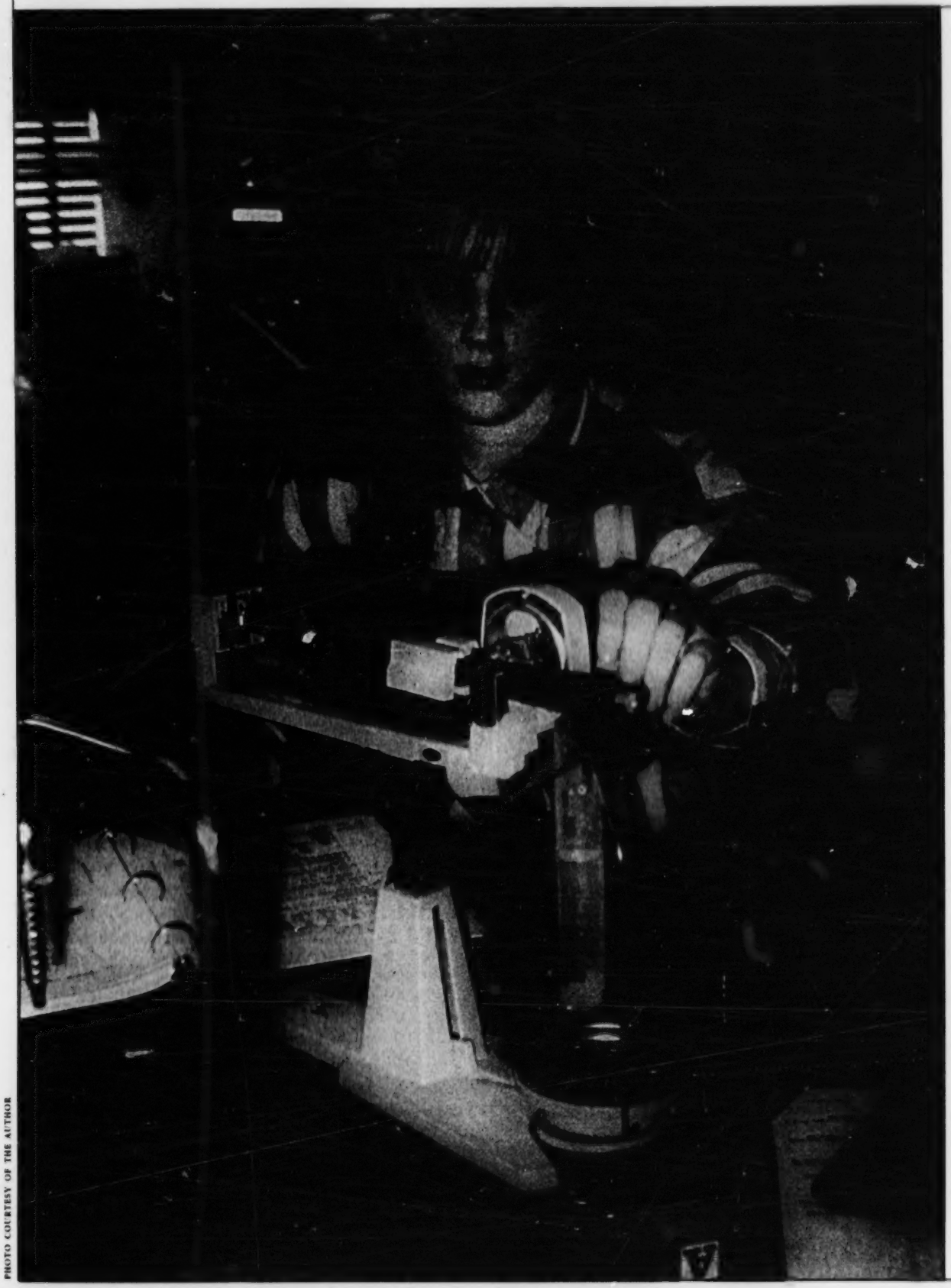


PHOTO COURTESY OF THE AUTHOR

FIGURE 1.

Sample student schedule.

Laramie High School Eight-Period Day

Period 1		
Period 2		
Lunch		
Period 3		
Period 4		ve)
Period 5		e)
Period 6		Resource
Lunch	11:05-11:50	
Period 7	11:55-1:25	Geometry
Period 8	1:30-3:00	World History (elective)

Teachers who tried to cram two of their former 55-minute lectures into one 90-minute period only succeeded in boring the students. Block science classes, which are activity oriented, became very popular and our enrollment jumped after the first year. The math department became more group oriented with cooperative learning activities. English classes took over the computer lab so students could write.

TIME IS OF THE ESSENCE

In science, I finally have more time to explore concepts I thought students understood. With more time to assess, I realize even hands-on activities are not enough to help students reach comprehension. Students need more time to analyze information, make conclusions, and discuss results. In the former 55-minute period, my students did labs, answered lab sheets, and often left the analysis section blank when the bell rang. Due to a lack of follow-up time, I would mark their grade down on the analysis section, but never really return to the problem. My students seemed to prefer having a few points taken off to the alternative—thinking about and analyzing the problem. With 90 minutes, I have time to introduce labs,

FIGURE 2.

Goals for restructuring.

- All students can successfully learn and achieve the school's curricular outcomes given sufficient time.
- Students have the potential to achieve at a much higher level of quality than is currently accepted.
- Success is the key motivator for increased student achievement. Success breeds success.
- Schools control the conditions for success. The structure developed and strategies used can assure success for all students.
- Success is judged on the basis of student outcomes. Outcomes are demonstrations of learning measured by a variety of methods including projects, authentic (real-life) assessments, portfolios, criterion-referenced tests, teacher-made tests, and standardized tests.

* From Laramie High School Restructuring Committee Report

FIGURE 3.

Rationale for block scheduling.

Longer class periods allow students extended time for lab work, hands-on projects, field trips, thorough discussions, varied teaching styles, and in-depth study. The projected benefits that students will have with this schedule are:

- Improvement in student academic success and achievement.
- Increased opportunity for more individualized and personalized attention and instruction due to a period of longer duration, more varied instructional strategies, and an advisement period.
- Greater opportunity to take elective classes.
- Fewer classses to prepare for in a 24-hour period so quality of work can increase.
- Expansion of opportunities to make up missed assignments during the educational resource period.
- Opportunity for students to assume more responsibility for their own learning.
- More flexibility in taking university or high school work-release programs.
- Improved school climate through reduced stress and a calmer school day.

* From Laramie High School Restructuring Committee Report

BEST COPY AVAILABLE

do the work, and analyze the results in groups and as a class before the bell rings.

Although we were initially worried about meeting every other day, students, teachers, and parents have shown a strong preference for the schedule, and few attempts were made to change it after the first year. After three years, we have begun devising curricula to meet block scheduling rather than worrying about the time frame.

THE DOMINO EFFECT

I first realized how valuable the longer periods were when my students completed the final lab unit on density. I had previously used this lab in 55-minute chemistry and geology classes. After the class completed activities that involved measuring and graphing to determine density, I had time left over in the 90-minute period to ask, "If you cut an object in half, will the density be the same?" While my students could memorize the formula for density and work density problems, they demonstrated to me during the next 30-minute exercise that they did not really understand the concept.

Because density is a ratio of mass over volume (D = mass/volume), I hoped students would refer to the relationship of the ratio because if both mass and volume are increased or decreased proportionally, the density should remain the same. But from A-students to F-students, my classes could not answer this question. I then devised a short experiment called "Domino Density" (Figure 4) to let students experience the problem during the next class period.

I asked the students to weigh and measure two dominoes and then do the same with one domino. They had trouble following the directions to place the dominoes on top of each other and sometimes laid them side by side. Even more frustrating, they had trouble analyzing data when the two dominoes were not exactly identical in size. They certainly could not answer the question of whether the density was the same with one or two dominoes (Figure 5). A simple problem had turned into a nightmare. With more time to work with the students, I realized they did not understand density, ratios, or the directions. Another 90-minute class was spent putting their answers on the board and analyzing the class data. We wrote a sentence together beyond the answer "yes" that explained the results.

FIGURE 4.

Domino density experiment.

Question: If you cut an object in half, does it have the same density as the original object?

Materials: 2 dominoes
gram scale
ruler

Procedure:
1. Weigh the two dominoes together.
2. Place one domino on top of the other.
3. Measure the length and width of the dominoes. Then measure the height of the two dominoes when they are on top of each other.

Record:

Weight of two dominoes	_____g
Length of dominoes	_____cm
Width of dominoes	_____cm
Height of two dominoes together	_____cm
Calculate volume of two dominoes together	_____cm^3
Calculate density of two dominoes together	_____g/cm^3

(Hint: Density = mass/volume)

Second Procedure:
1. Separate the two dominoes.
2. Weigh one domino.
3. Measure lwh of one domino.

Calculate volume of one domino	_____cm^3
Calculate density of one domino	_____g/cm^3

Answer in sentence form:
If you cut an object in half, does it still have the same density? Why?

FIGURE 5.

Student responses.

Question: If you cut an object in half, will the density change? Why?

No. Because the mass and volume would be different.

Yes. Because you don't change the density, just the volume and mass.

No. Because there is not as much volume.

No. Because there is half the object.

No. Both halves together must have more density and the mass and volume would be different.

Yes. If is = then the 2 sides together will = the huge mass so that when it's ÷ into half it will = 1/2 of the 2 together.

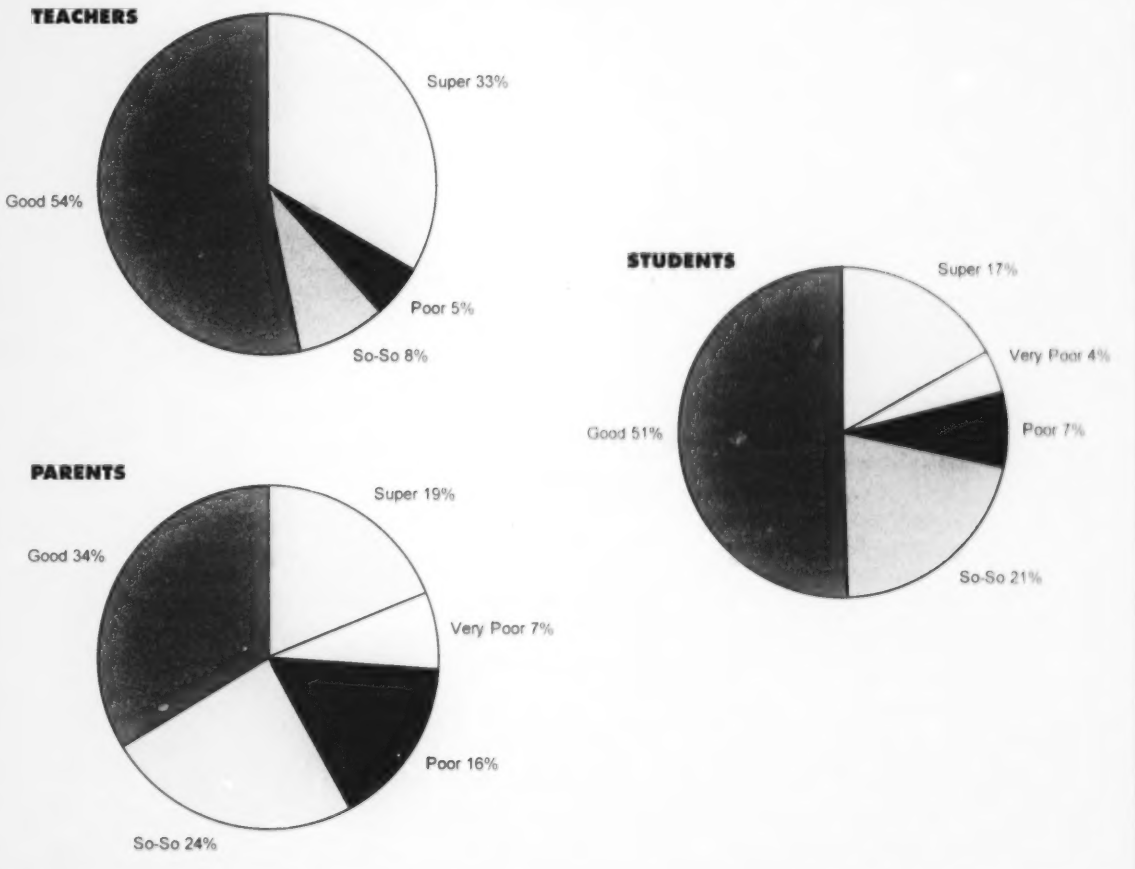
THE JOY OF BLOCKING

I am often asked if we cover as much material in a block schedule. The answer is no. There are not as many contact minutes, and once you realize how much the students do not understand, it is hard to go on to something new until you take time to resolve the problem. The learning is far more intense, however, and time for group and cooperative work is available. As our teachers have reiterated in our block meetings (one-fourth of our teachers can now meet regularly during their preparation periods), we waste less time and value every minute in this schedule. We tend to emphasize the concepts that are really important. The schedule change became the vehicle for curriculum change in our school. As our satisfaction comparison (Figure 6) after the first year indicates, we would not go back. ✧

Janet L. Gerking is a science teacher at Laramie High School, 1275 North 11th, Laramie, WY 82070.

FIGURE 6.

Satisfaction comparison after first year of block scheduling.



NEW CLASS ON THE BLOCK

One school's successful change to block scheduling

SMALLER CLASSES AND INCREASED student-teacher interaction are just two of the advantages of block scheduling. Other advantages include long blocks of instructional time, fewer interruptions per class, more time for in-depth focus on a particular topic, and uninterrupted experimental and laboratory procedures.

At Center High School, we feel these and other advantages far outweigh the few disadvantages of block scheduling. In this article, I will outline some typical 90-minute lessons in various science classes.

Center High School has an enrollment of approximately 200 students in grades nine through twelve. Because of its small size, I am the only science teacher and am responsible for teaching all general science. To graduate, students must pass a minimum of three science courses. It does not take long for students to figure out that they are stuck with me for these classes.

We have used block scheduling for five years and have modified it to meet the needs of all disciplines. This year, we will use two 90-minute blocks, two 50-minute blocks, and one 75-minute block (Figure 1). The 90- and 75-minute blocks meet every day for 18 weeks and are worth one credit. These classes then change to other block classes for the second semester. The two 50-minute blocks meet the full year and are also worth one credit each.

BY TERRILEE DAY

Block scheduling is ideal for science classes. In one 90-minute period, the teacher can introduce or reinforce a major concept, incorporate an experimental or research activity to enhance the concept, and still have time for follow-up activities or discussions that provide closure. The first few minutes of the next class period can then be used to check student understanding while still allowing plenty of time to move to a related topic.

An obvious, but often underestimated, advantage of this schedule is the fewer number of starts and stops during the day (Figure 2). I take attendance four times a day, rather than six or seven. This allows more time for me to get to know my students better and to work with their particular needs and abilities. The reverse is also true; my students get to know me better than they would with a traditional schedule. This helps keep a positive classroom atmosphere that leads to fewer disciplinary interruptions.

A DAY IN THE LIFE

We just finished a unit on bacteriology in biology class. In one class, I introduced some basic information about

PHOTO BY BRENDA HAMILTON

bacteria, including their shapes, nutritional requirements, and identification characteristics.

The students then broke into teams and conducted an experiment in which they cultured different areas of the school with sterile cotton swabs. Then they swabbed an agar plate and incubated the plate for two days. After they swabbed their test sites, we discussed ways to prevent bacterial growth and the importance of these methods in our lives. I asked students to think of ways in which we inhibit bacterial growth in food and the importance of certain bacteria in our lives. Their homework assignment was to find products at home made with the help of bacteria and to bring one item to class the next day.

The second day, we discussed the products that students brought from home. Since some products were from fungal organisms rather than bacteria, we discussed differences between these two kingdoms of organisms. Here, my students directed the discussion to the next topic with very little prompting from me. As we continued our discussion of the harmful effects of bacteria, students asked about household products that claim to kill bacteria (for example, mouthwash). This led to an experiment in which we tested various household mouth products for their effect on bacteria. These plates were also incubated for two days.

On the third day, we returned to the set of plates we prepared on the first day. The class was surprised to see the bacterial colonies. We collected class data to determine the area with the highest growth. In most classes, this was in one of the bathrooms. The students concluded that bathrooms were not clean areas and realized the importance of washing hands after using the facilities. Some students even mentioned state regulations that govern food workers. The students also concluded that all tested areas grew some bacteria. This reinforced the idea that different species of bacteria have different growth requirements, but that bacteria are hardy and versatile organisms.

Since the class wanted to know what types of bacteria they had grown, we performed a Gram stain procedure on their colonies. The 90-minute block allowed students to complete the staining and observe the slides in the same day. After the observations, we discussed how and why bacteria are identified in medical laboratories.

On the fourth day, we observed the plates set up on the second day to test the bactericidal effects of various mouth products. After collecting class data, we still had enough time to summarize all the information we had gathered about bacteria and to review the basic concepts of the unit.

THE PERFECT SETUP

Ninety-minute blocks of time are perfect for chemistry class. Even with the arrival of more time-saving microscale

FIGURE 1.

Block scheduling of science and mathematics courses.

Period 1 90 minutes 8:15-9:45	Period 2 90 minutes 10:00-11:30	Period 3 55 minutes 11:40-12:35	Lunch 12:35-1:05	Period 4 50 minutes 1:05-1:55	Period 5 75 minutes 2:00-3:15
Chemistry	Biology	Adv. Biology		PREP	Biology
Algebra	Geometry	PREP		H.S. Computer	Pre-Algebra
Pre-Algebra	Spanish I	Applied Math		Consum. Math	Spanish II
Algebra	General Science	Algebra		PREP	Physics

experiments readily available for classroom use, chemistry labs require more set-up and clean-up time. The larger blocks of class time allow concept introduction, reinforcement using an experiment or demonstration, and time for postlab discussion and/or problem-solving sessions. After teaching chemistry in 90-minute blocks of time for five years, I would not want to go back to traditional class periods.

To introduce a unit on gas laws, I started one class by discussing the molar volumes of gases and standard temperature and pressure conditions. The students followed up on this lecture by collecting hydrogen gas produced from the reaction of magnesium ribbon and hydrochloric acid.

This year, for the first time, students performed this experiment on the microscale level with great results. Because the class had massed the ribbon before the reactions, they calculated the moles of magnesium used. In the postlab discussion, we wrote the equation for the reaction, determined the type of chemical reaction that took place, used stoichiometry to predict the number of moles of hydrogen gas produced, and determined the leftover product.

FIGURE 2.

Bell schedule at Central High School.

8:12	Warning bell
8:15	Tardy first hour
9:45	End first hour
9:57	Warning bell
10:00	Tardy second hour
11:30	End second hour
11:37	Warning bell
11:40	Tardy third hour
11:45	End of Middle School lunch hour
12:35	Lunch
1:02	Warning bell
1:05	Tardy fourth hour
1:55	End fourth hour
2:00	Tardy fifth hour
3:15	End of school day

In this one class period, students used several different skills and concepts that had been previously introduced: formula and equation writing, classifying chemical reactions, and problem solving using stoichiometry. If this follow-up had been delayed until the next day (or the next week if this lesson had begun on a Friday), it would not have been nearly as effective.

LESSONS LEARNED

We have used several modifications of block scheduling at our school. Although four 90-minute blocks are effective for science classes, not all subject areas are best served with this arrangement. We modified one of our 90-minute blocks into two 50-minute blocks to better meet the requirements of those classes that need to meet with the same students the full year (such as band, yearbook publications, language development, and enrichment).

Because of this modification, I had to choose a science class that would meet for 50 minutes every day throughout the year. I chose advanced biology, which at our school is human anatomy and physiology. This class seemed to require the least amount of laboratory set-up and clean-up time. It is not a perfect schedule, but we are learning new things as we implement some form of the block schedule concept each year.

In my estimation, the compromise is worthwhile if it means keeping the other classes as blocks. Almost every day, I look at my watch about halfway through the class period, when students are actively involved in an activity, and wonder how I ever taught a complete lesson in the traditional time period. An unexpected result of block scheduling is that it forces teachers to become better at planning, presenting, and reviewing lessons and concepts; a result that benefits the most important people of all—students. ✧

Terrilee Day is a science teacher at Center High School, P.O. Box 730, Center, CO 81125.

A Lesson in ...Block Scheduling

HILLCREST HIGH SCHOOL IN SPRINGfield, Missouri, started using a block schedule five years ago. The school now has a schedule that features four classes per day Monday through Thursday. On Monday and Wednesday blocks 1, 3, 5, and 7 meet, while on Tuesday and Thursday blocks 2, 4, 6, and 8 meet. Each block is 80 to 85 minutes. On Friday all classes meet, achieving closure for the week.

This schedule presents a problem for teachers because teaching styles must be changed from those appropriate for 45-minute periods. It is almost impossible to keep students' attention for a full 85 minutes of lecture or discussion. Once in a while a topic of interest is discussed or lectured for the full time, but that is the exception. As a result, teachers need to conduct two, and possibly three, activities during the block. Some teachers give a short lecture followed by a question-and-answer session, have students work in small groups, then show a short video or movie, and so on. This format usually keeps students on task, interested, and active.

The following is a lesson plan we have used successfully in biology classes:

HOW CAN ORGANISMS BE CLASSIFIED?

The first 10 minutes of class are student directed. Each pair of students is given unlabeled drawings or photographs of insects. The pair then works together to try to name the pictured insects. One student records the name of each insect. Students in each pair can talk only to one another as they discuss the possible identity of each insect. They are reminded that they are not expected to know or guess all the correct identities at this time; they should be having fun.

The next 10 to 15 minutes are teacher directed. Students receive a dichotomous key for identifying insects. The teacher explains the purpose of a dichotomous key, how it is constructed, and how it is used.

The following 10 to 15 minutes are student directed. Students, still working with the same partner, use the dichotomous key to determine and record the actual names of the insects. When finished, the pairs compare their answers with an answer key and with their original responses.

The next 20 minutes of the block are teacher directed. The teacher prepares students for the last section of the period by using an overhead projector to explain how to construct a dichotomous key.

The last section of the blocked period is student directed. Students are given 12 drawings of higher orders of primates. We switch to primates here because students are trying to construct a dichotomous key, and students are better able to recognize traits and relate more closely to primates than they would to insects. A student volunteer conducts a brainstorming session, and all students suggest contrasting primate traits or characteristics to use in preparing a dichotomous key for the 12 drawings. The student volunteer records the contrasting forms of each suggested trait on a transparency as students record them on notebook paper for later use. (Some suggested traits include large eyes for head size or small eyes for head size, tail or no tail, flat nails, and opposable thumb or claws without opposable thumb.)

We have had success with block scheduling because teachers have been receptive and cooperative in throwing away old lesson plans. They devised new plans to meet the needs of the block schedule. We have found that using two or three activities per block is most effective for keeping students on task and maintaining their interest. Teachers teach the same material they have always taught; they just rearrange the way they present it. As teachers we have always adjusted to different classes, students, principals, and superintendents—why not to a new schedule? ✧

BY ROBERT BARNES, JOYCE STRATON, AND MARY UKENA

Robert Barnes is biology department head, and Joyce Straton and Mary Ukena teach biology, all at Hillcrest High School, 3319 North Grant, Springfield, MO 65803.

Managing Each Minute

Strategies for reclaiming lost instructional time

BENJAMIN FRANKLIN ONCE NOTED that "lost time is never found again." This adage is especially true for time wasted in the classroom. Many educational reform movements have suggested that the school year be extended to allow more instructional time to better educate our students. These proponents rationalize increasing instructional time, in part, by citing research that shows a correlation between student achievement and engaged time. Constructivists learning theory also suggests that changing students' misconceptions requires much time and effort. Finally, implementing authentic assessment strategies will require a significant increase in class time as well.

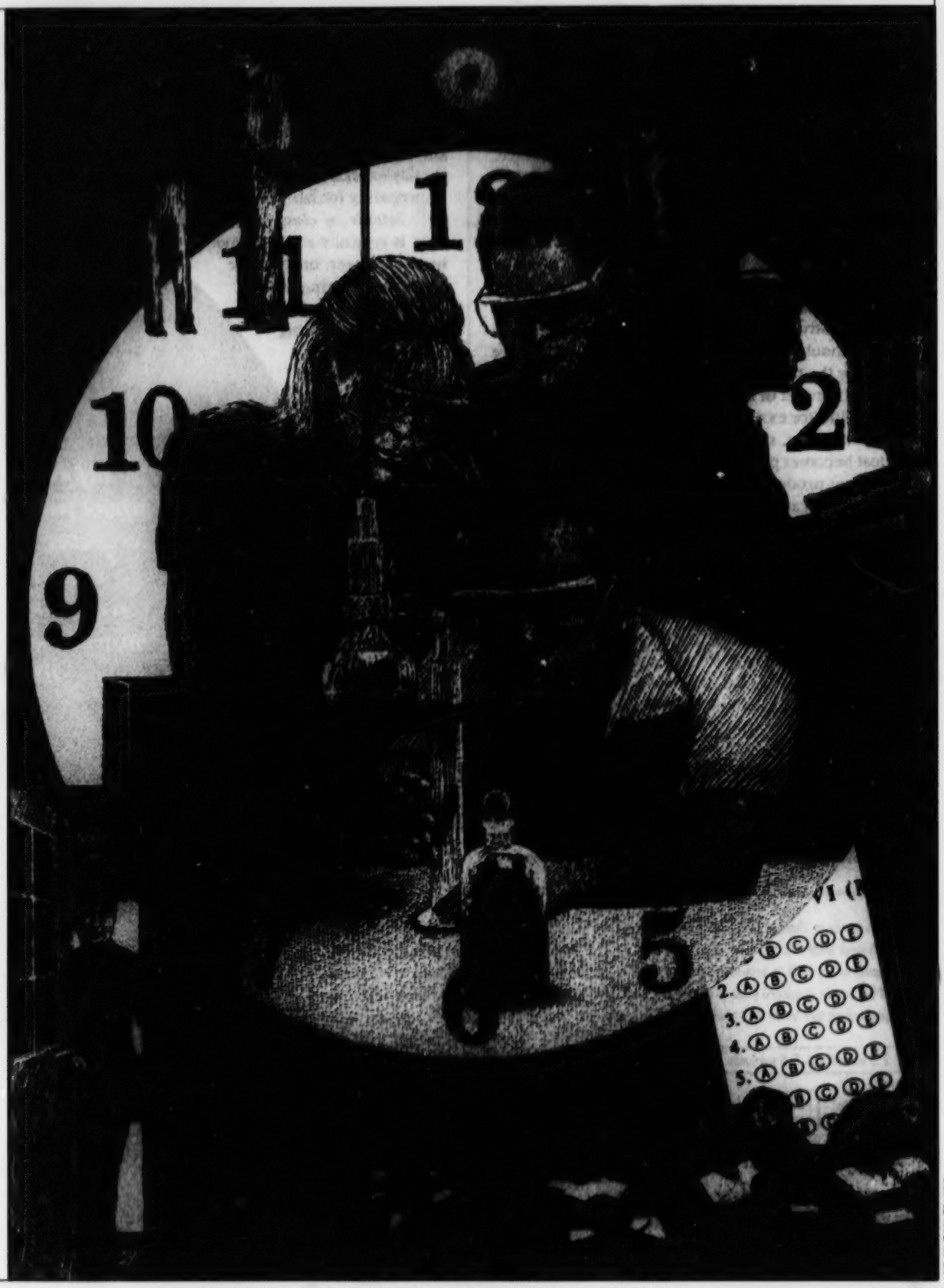
Unfortunately, while lengthening the school year might increase student achievement, public education cannot afford the costs of implementing such a proposal. The cost associated with extending the school year includes increasing administrator and teacher salaries, as well as multiplying general building and student transportation costs.

Given the budgetary crises our national, state, and local governments currently face, the money to extend the school year is simply not practical for most school districts. Consequently, much talk, but little action, ensues. Missing in the above debate is thoughtful discussion concerning how instructional time can be increased within the current school framework.

A TIMELY SOLUTION

A cost-effective strategy to increase engaged time is to determine where time is lost in the school day, and reduce this time. The emphasis on this might have been overlooked by many teachers and administrators because of the imperceptible nature of daily loss that, over the course of the school year, translates into significant time. For example, consider the results of an informal student survey we conducted at just a few schools in the

BY MICHAEL P. CLOUGH, RANDAL J. SMASAL, AND DOUGLAS R. CLOUGH



ART BY TOM TEAGUE

upper midwest United States. The surveys (with directions) were passed out to students as they entered the door. Attendance was taken while students completed the surveys, and instruction was begun within 30 seconds after the bell.

The data we collected indicated that, on average, 2.5 minutes pass between the bell ringing and class beginning. Moreover, on average, 5.5 minutes are provided at the end of class for students to socialize or to do work for other classes. What initially appears to be a short amount of time lost from instruction becomes profound when calculated for the school year (Figure 1). Note that almost 29 instruction periods of 50 minutes are lost in a 180-day school year. And this assumes that students are productive the remaining 42 minutes of class. If we add to this the number of intrusions that teachers are far too familiar with (for example, assemblies, state and federal mandated testing, sports, and so on), the instructional time lost becomes profound. Researchers have reported that student productive time is often as low as 30 to 55 percent of allocated time.

TIME MUST BE RECLAIMED

Before the school year is extended, we must first reclaim lost instructional time! This reclamation can come from (see Figure 2):

Beginning of class. Instruction should begin immediately after the bell rings. We usually engage students in a productive task so that we can attend to administrative duties. At times we have students working before the bell rings (this is easily accomplished when motivating projects are underway), thereby gaining instructional time. The beginning of class is extremely important because it sets the tone for the remainder of the period.

Daily announcements. Most schools have a time when messages are broadcast over the school intercom. During announcements, students should be writing down the day's agenda, writing in their science journals, or preparing for lab work.

Middle of class. Instructional time is typically at a maximum here. However, time can be lost in many ways, such as when students ask for passes, do not bring needed materials to class, or are allowed to use class time for acquiring missed assignments. Time is also lost when class is unnecessarily interrupted by outside influences. These disruptions not only directly take away instructional time, but often make getting students back on track difficult.

Before the school year is extended, we must first reclaim lost instructional time.

These occurrences can be drastically curtailed. For example, sufficient time is typically provided between classes for students to attend to personal matters and go to their lockers. We grant all requests for hall passes (we cannot tell when a student legitimately needs one), but also enforce a 10-minute penalty for each pass. You might be surprised how many students ask for a pass, but when reminded of the 10-minute penalty, decide they can wait until the end of class. Penalties also exist for students not prepared for class. Students who miss school must determine what is to be made up on their own time, not during class. Because these standards are enforced, we rarely have interruptions during class.

End of class. Our experience and the results of our informal survey suggest that students expect to have the last few minutes of class to socialize. What is surprising is how often this socializing is allowed. Clearly, 15 to 30 periods of instruction can be picked up simply by having

FIGURE 1.

The following is a nice problem to have students solve when teaching the factor dimensional method, and it provides a justification for our demand that students work from bell to bell.

Students in some classes (not mine of course) do not use the first 2.5 and final 5.5 minutes of a 50-minute period. If this happened every day in science class, how much instructional time would be lost in a school year (180 days)? How many periods is this equivalent to? Why do I make you work from bell to bell?

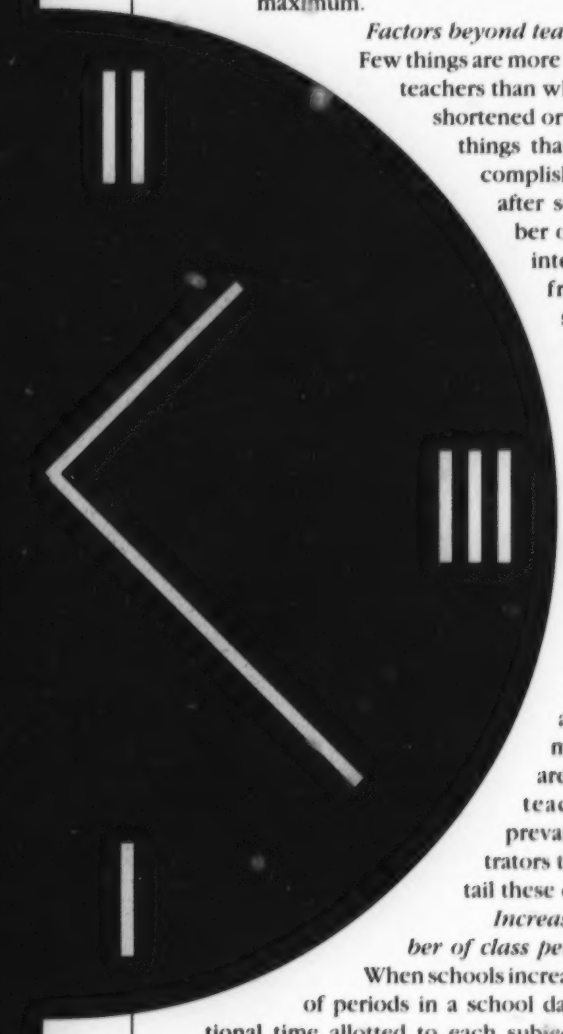
2.5 minutes + 5.5 minutes = 8 minutes lost per class period

$$\frac{8 \text{ minutes lost}}{1 \text{ class period}} \left| \frac{180 \text{ class periods}}{1 \text{ school year}} \right| \frac{1 \text{ class period}}{50 \text{ minutes}} = 28.8 \text{ lost class periods}$$

One student's response:

Not working these eight minutes each day is like being absent from a class 29 times in a school year.

students work from bell to bell. Not only do we demand that students work to the end of class, but class continues until we dismiss the students. We discourage students from gathering their things together until we have dismissed the class. These policies, along with consistent monitoring, ensure that students' engaged time is at a maximum.



Factors beyond teachers' control. Few things are more bothersome to teachers than when classes are shortened or eliminated for things that could be accomplished before or after school. A number of instructional interruptions are frivolous and should be eliminated. Mandated tests, like college entrance exams, should be given after school or on Saturdays. Intrusions into a well-working classroom, such as sudden announcements or calls, are disruptive and teachers should prevail on administrators to severely curtail these disruptions.

Increasing the number of class periods per day. When schools increase the number of periods in a school day, the instructional time allotted to each subject is markedly reduced (Figure 3). Although adding periods to a school day is a popular way of educating more students with limited resources, both teachers and administrators should be aware of the effects on instructional time.

DESCRIBING AND ENFORCING EXPECTATIONS

The environment we have described is not tyrannical. Constructivist and Piagetian learning theory suggest that students must be actively involved in learning—observing, predicting, testing, and working together. We strive for a structured classroom without structuring the students' thinking. Effective management is essential for a

FIGURE 2.

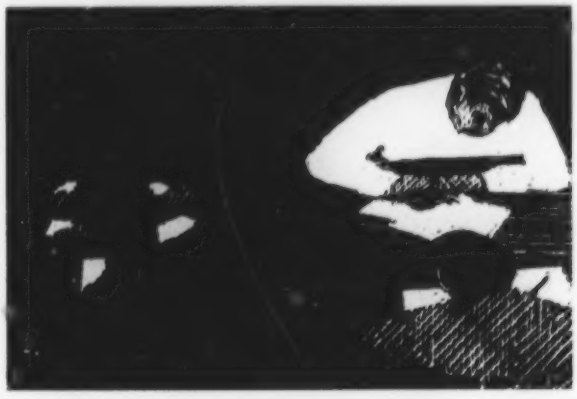
Guides for effective time management.

Teachers should:

- Clearly and strongly communicate, orally and in writing, student expectations (and penalties for infractions) at the beginning of the school year. These should have the support of the administration;
- Implement activities that require students to be actively doing science (i.e. observing, predicting, and designing experiments);
- Require students to write down daily assignments in their notebook immediately after the bell rings;
- Pass back corrected assignments before class begins so that no instructional time is wasted;
- Organize and distribute materials and equipment in an orderly fashion so that students do not waste time acquiring things;
- State time expectations for completion of tasks done in class (for example, I will provide you five minutes to write down at least seven characteristics of living things);
- Monitor extensively;
- Overplan lessons so that if the planned lesson finishes early, no "dead" time occurs at the end of class;
- Plan for students' attention spans. For example, lecturing to middle school students for more than 10-15 minutes is asking for off-task behavior;
- Deal with discipline quietly and respectfully on an individual basis to reduce the risk of drawing the entire class off task;
- Set specific time penalties for passes to the restroom, locker, etc. Enforce rules requiring students to be prepared for class;
- Require students who have been absent to come in before or after school to determine what was missed;
- Have students write in their science journal the first or final few minutes in class (see "Reflective Reading" in the November 1992 *The Science Teacher*).

constructivist classroom because students are expected to be active from bell to bell. Therefore, students will be doing things they might not be accustomed to. Consequently, teachers have to teach students how to behave in this new environment and enforce the standards.

Teachers must train their students, during the first five weeks of the school year, to use their time effectively. The expectations (academic as well as behavior) set at this time become the standards for the year. Relaxing the standards is always possible, but increasing the standards is extremely difficult. Evertson and Emmer (1980) found that teachers who clearly set their expectations at the beginning of the school year had less time-off-task throughout the year. However, these standards cannot be enforced in the classroom without strong administrative support.



CONCLUSION

Knowledge of allocated time versus productive time, as well as their implications for practice, are important components in a research-based rationale for teaching science (Clough, 1992). Moreover, because administrators look for time-on-task, awareness of this research is another way of being proactive in evaluation (Berg and Clough, 1991).

If increasing instructional time is to be a serious goal, then time must be gained within the current school year. With teacher perseverance and administrative support, a minimum of 15 to 30 days of instruction can be gained within the current typical middle and high school year. Using the guidelines outlined here, classroom instructional time can be increased without an additional financial burden to taxpayers. ◆

Michael P. Clough is a biology and chemistry teacher at Memorial High School, 2225 Keith St., Eau Claire, WI 54701. Randal J. Smasal is an biology teacher at Roosevelt Middle School, 650 Main St., Blaine, MN 55434. Douglas R. Clough is an English teacher at Ida Grove Middle and High School, Ida Grove , IA 51445.

FIGURE 3.

Breakdown of science education.

Case 1: Seven period school day

$$\frac{\text{50 minutes}}{\text{class period}} \;\Big|\; \frac{\text{180 class periods}}{\text{1 school year}} = \text{9000 minutes of allocated science instruction}$$

Case 2: Eight period school day

$$\frac{\text{44 minutes}}{\text{class period}} \;\Big|\; \frac{\text{180 class periods}}{\text{1 school year}} = \text{7920 minutes of allocated science instruction (88\% of case 1)}$$

Case 3: Ten period school day

$$\frac{\text{35 minutes}}{\text{class period}} \;\Big|\; \frac{\text{180 class periods}}{\text{1 school year}} = \text{6300 minutes of allocated science instruction (70\% of case 1)}$$

FOR FURTHER READING

Berg, C.A. and Clough, M.P. 1991. Generic lesson design: the case against. *The Science Teacher* 58(7):26-31.

Berliner, D. 1989. Effective schools: teachers make the difference. *Instructor* 99(3):14-15.

Clough, M.P. 1992. Research is required reading. *The Science Teacher* 59(7):36-39.

Evertson, C. and Emmer, E. 1980. *Effective Management at the Beginning of the School Year in Junior High Classes.* Austin: Research and Development Center for Teacher Education, University of Texas.

Meyers, S.S. 1990. The management of curriculum time as it relates to student engaged time. *Educational-Review* 42(1) 13-23.

Stallings, J. 1984. Effective use of classroom time. *Eric Document 251973.* In Sattes, B.D. (Ed.) *Promoting School Excellence Through the Application of Effective Schools Research: Summary and Proceedings of a 1984 Regional Exchange Workshop.* See EA 017379.

Walberg, H.J. 1988. Synthesis of research on time and learning. *Educational Leadership* 45(6):76-85.

Willis, S. 1993. Are longer classes better? *Update* 35(3):1-3. Association for Supervision and Curriculum Development.

Youngs, B.B. 1982. Schools can offer more instructional time at no cost. *NASSP-Bulletin* 66(454):49-51.

In the current climate of science education reform, one of the most talked about methods of effecting change is *block scheduling*, a restructuring of the traditional school day to accommodate longer class periods.

Block scheduling helps teachers realize the vision of the *National Science Education Standards* by affording time for longer and more thoughtful laboratory experiences, more reflective exploration, and more hands-on activities.

Block Scheduling, a compilation of articles by teachers who have successfully implemented block scheduling, features:

- Successful classroom strategies
- Tips on managing scheduling logistics
- Suggested activities for a 90-minute class
- A guideline for effective time management
- The pros and cons of the different types of block schedules

PB-139X
ISBN: 0-87355-163-

NSTA National Science Teachers Association

BEST COPY AVAILABLE